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(54) **TROUGH LUMINAIRE WITH MAGNETIC LIGHTING DEVICES AND ASSOCIATED SYSTEMS AND METHODS**

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F21V 23/00 (2015.01)
(Continued)

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USPC 362/135, 240, 396

See application file for complete search history.

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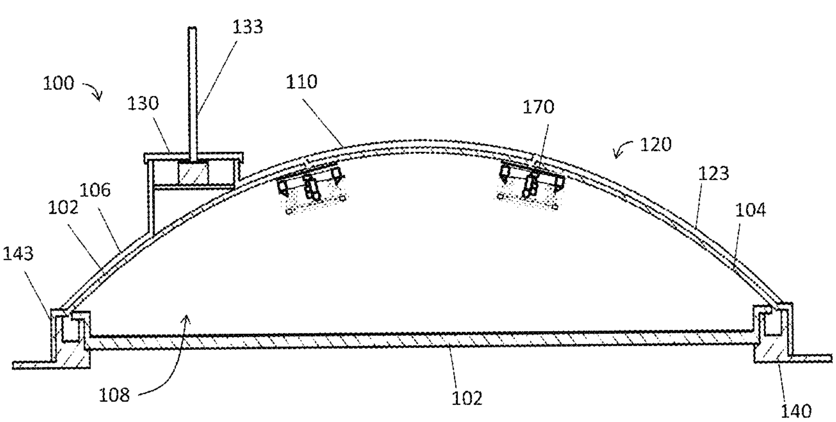
(57) **ABSTRACT**

A luminaire may be carried by a lighting fixture and may have a generally concave elongate-shaped housing defining an optical chamber and an aperture. The luminaire may include a plurality of lighting devices each having a heat sink, a light source, and a magnetic attachment member. The magnetic attachment member may magnetically bind a lighting device to pads proximate to ferromagnetic material in the housing. Light emitted by the light source may enter the optical chamber and pass through the aperture in a generally orthogonal direction in relation to the orientation of the device. Electrical power may be delivered by one or more power supply unit of either an external or an on-board type, and by using either inductive or conductive coupling. Network interfaces may enable communication of control instructions among a multiple controllers located either within a single luminaire or distributed among multiple luminaires.

21 Claims, 9 Drawing Sheets



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F21V 29/85	(2015.01)
F21Y 101/02	(2006.01)

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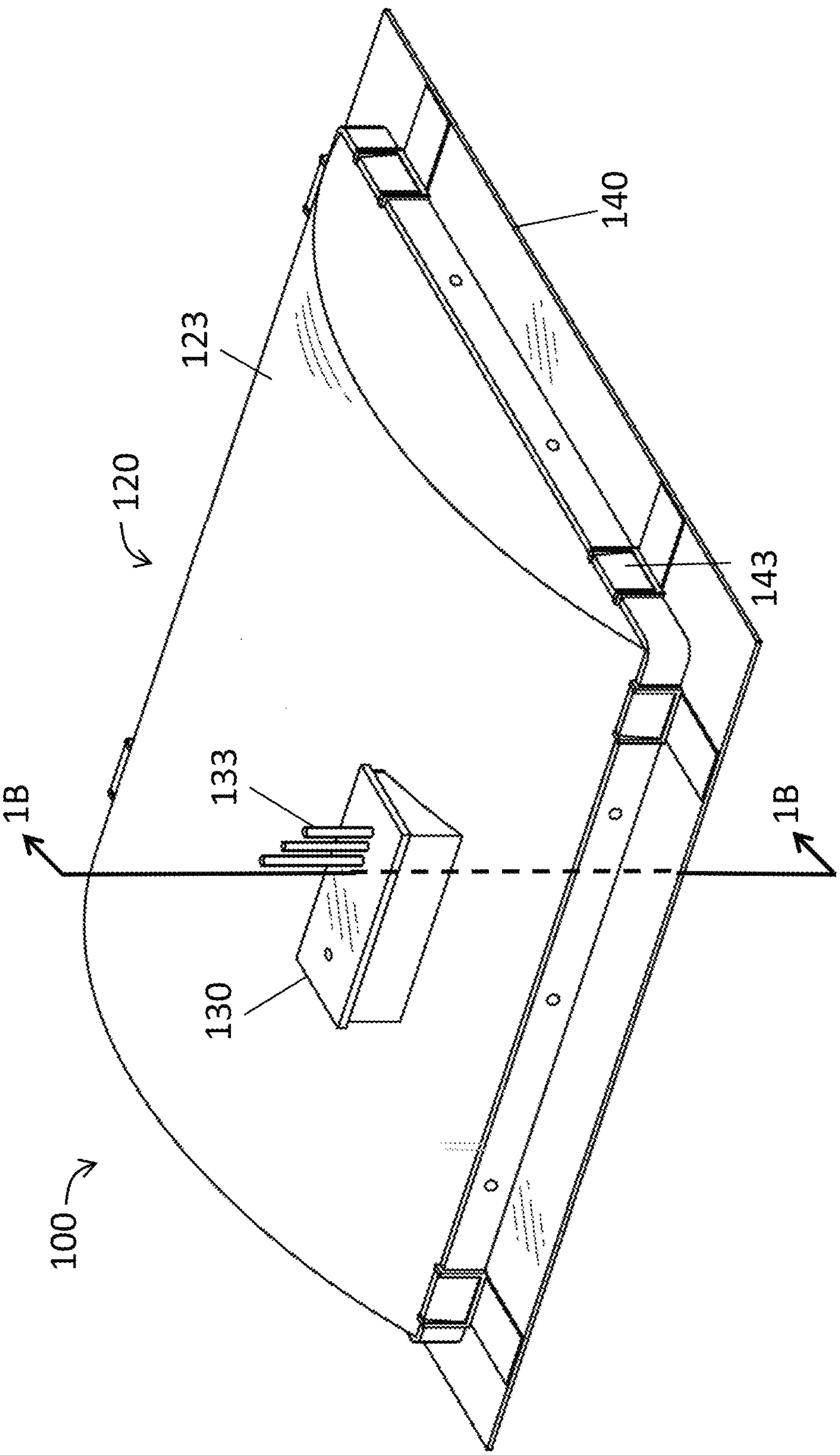

FIG. 1A

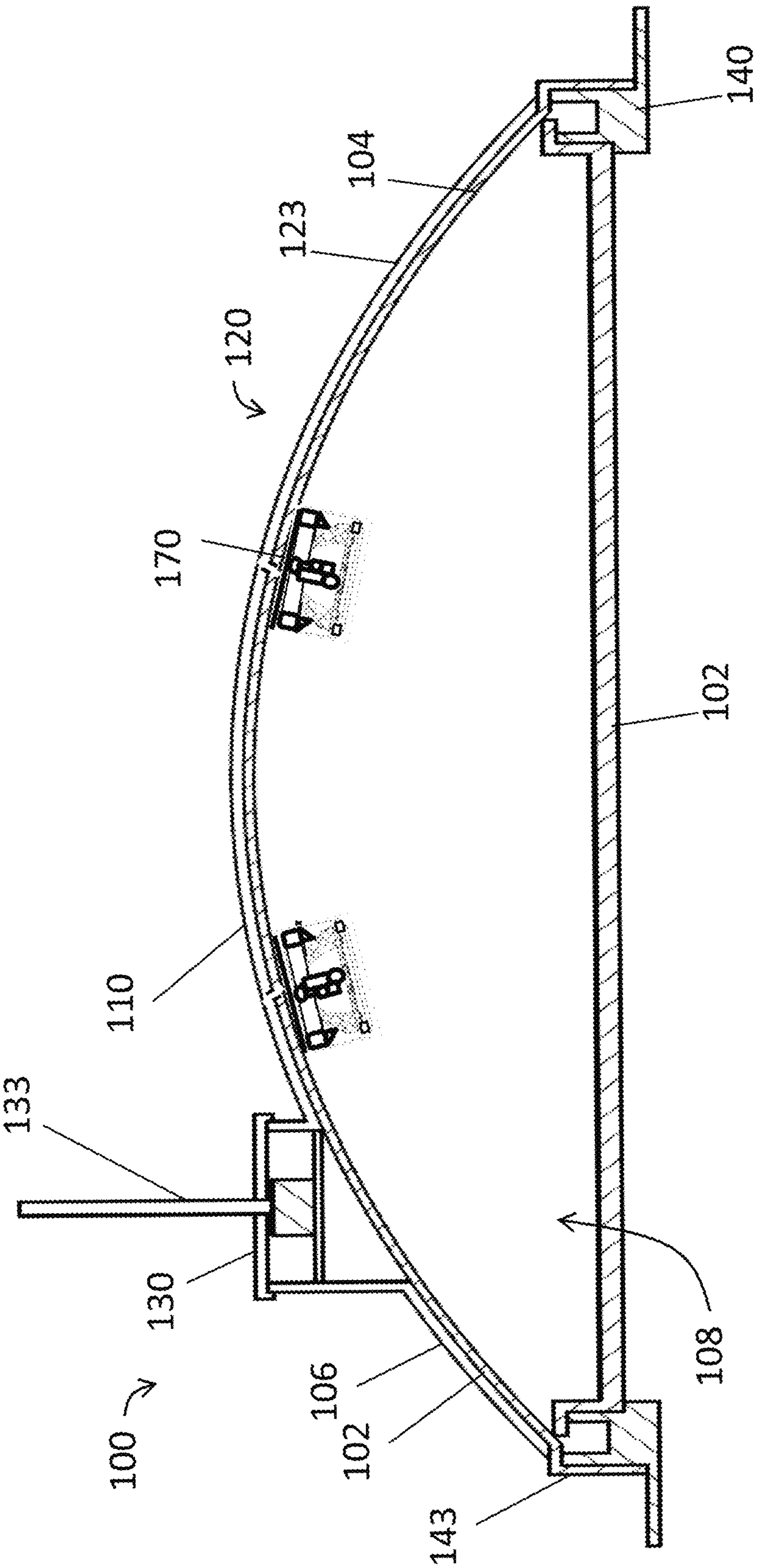

FIG. 1B

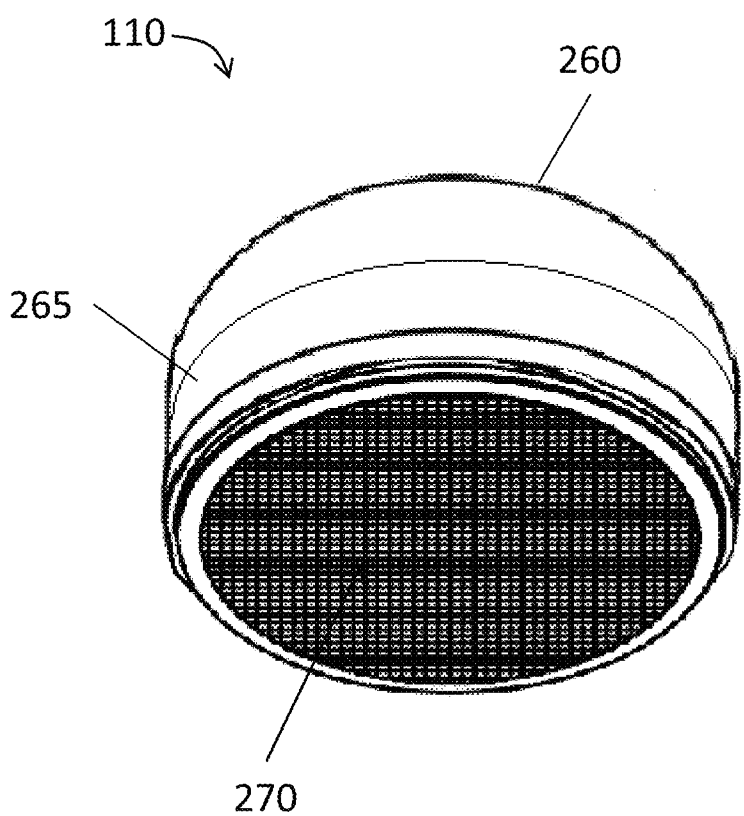

FIG. 2A

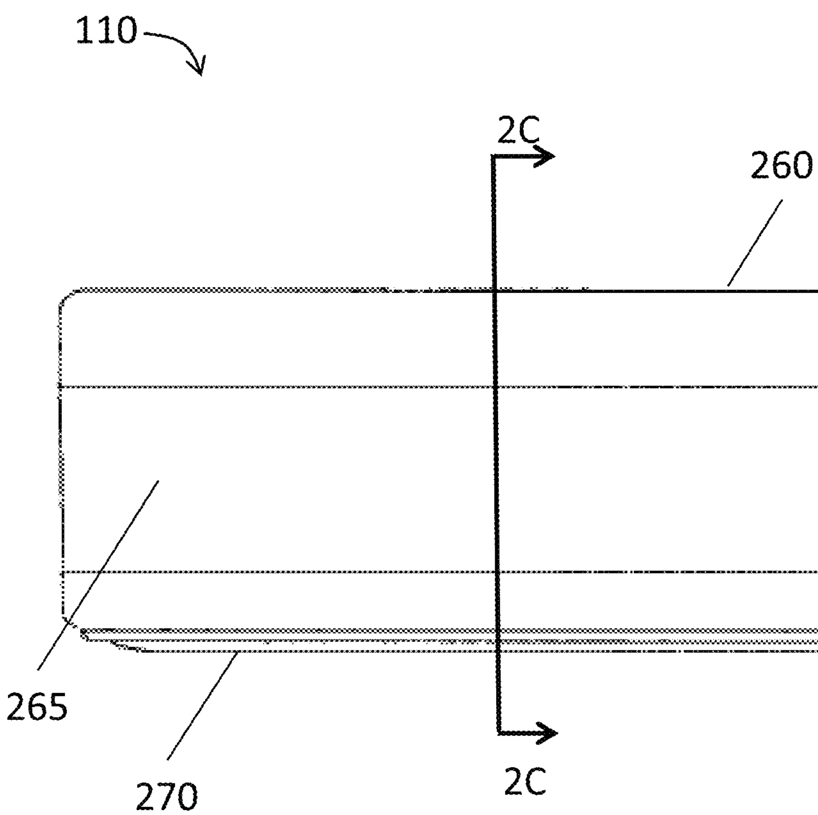

FIG. 2B

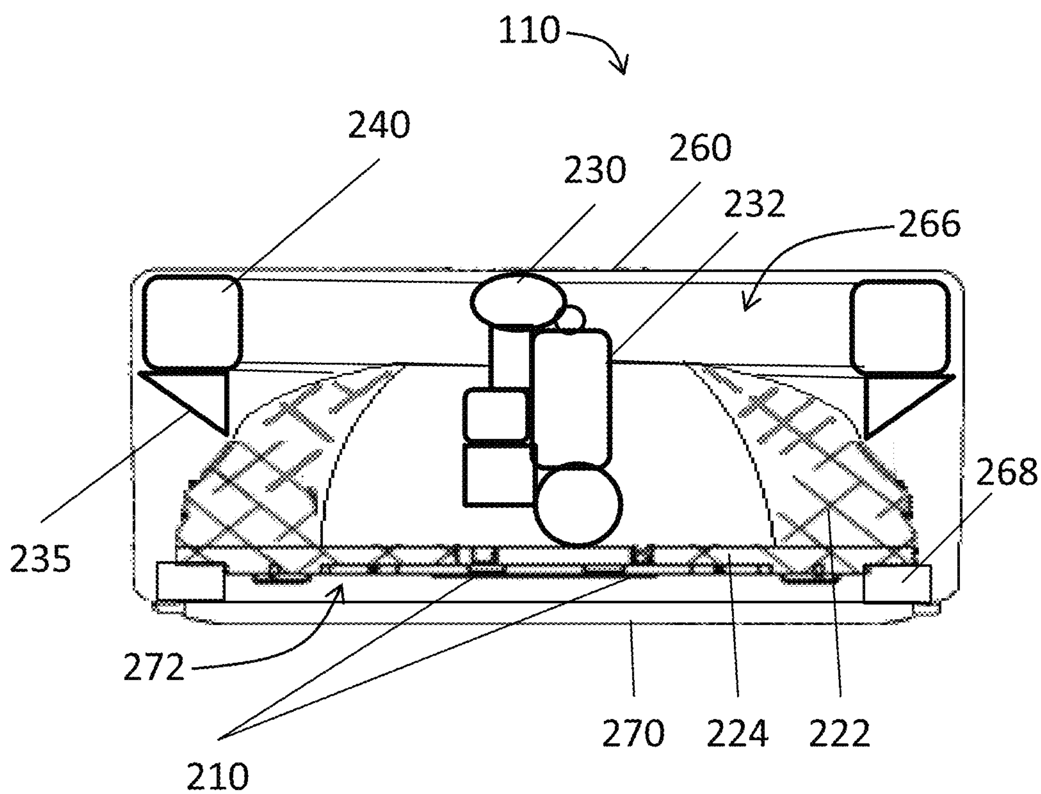

FIG. 2C

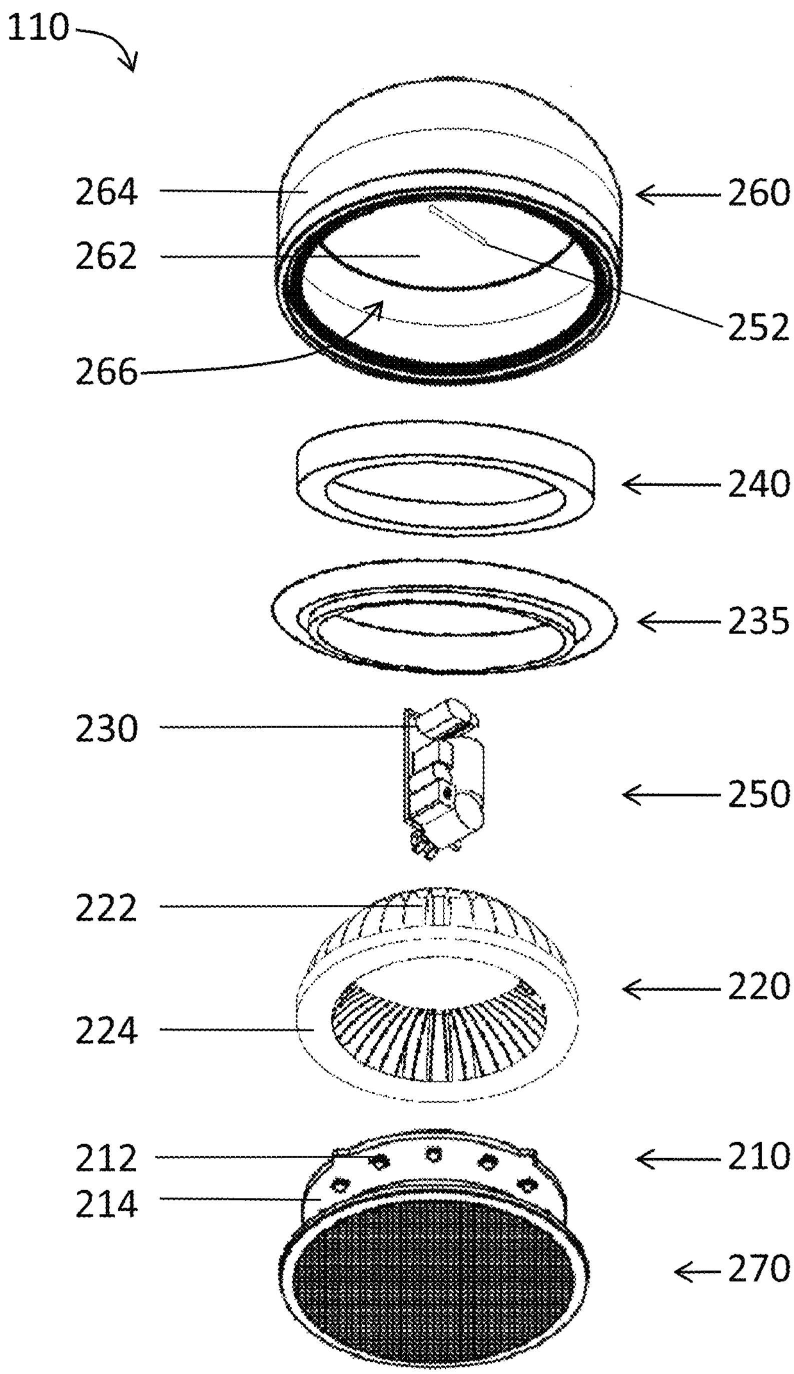
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FIG. 2D

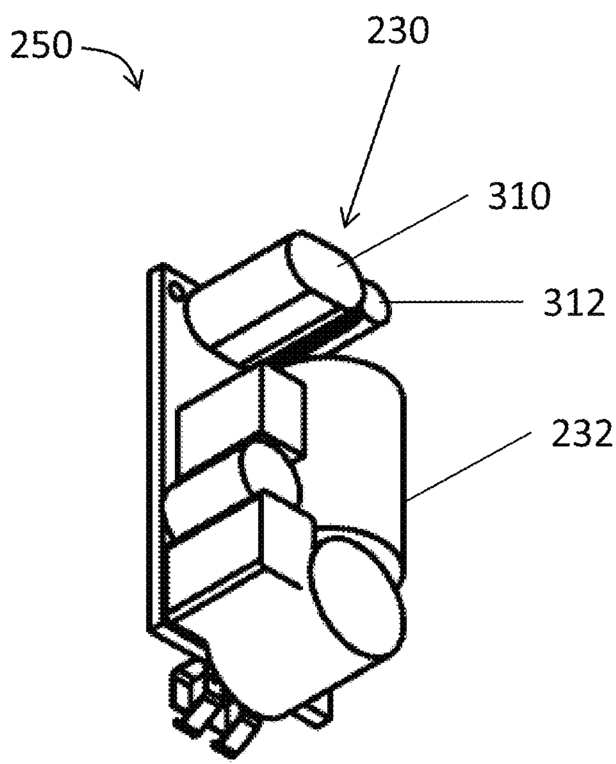
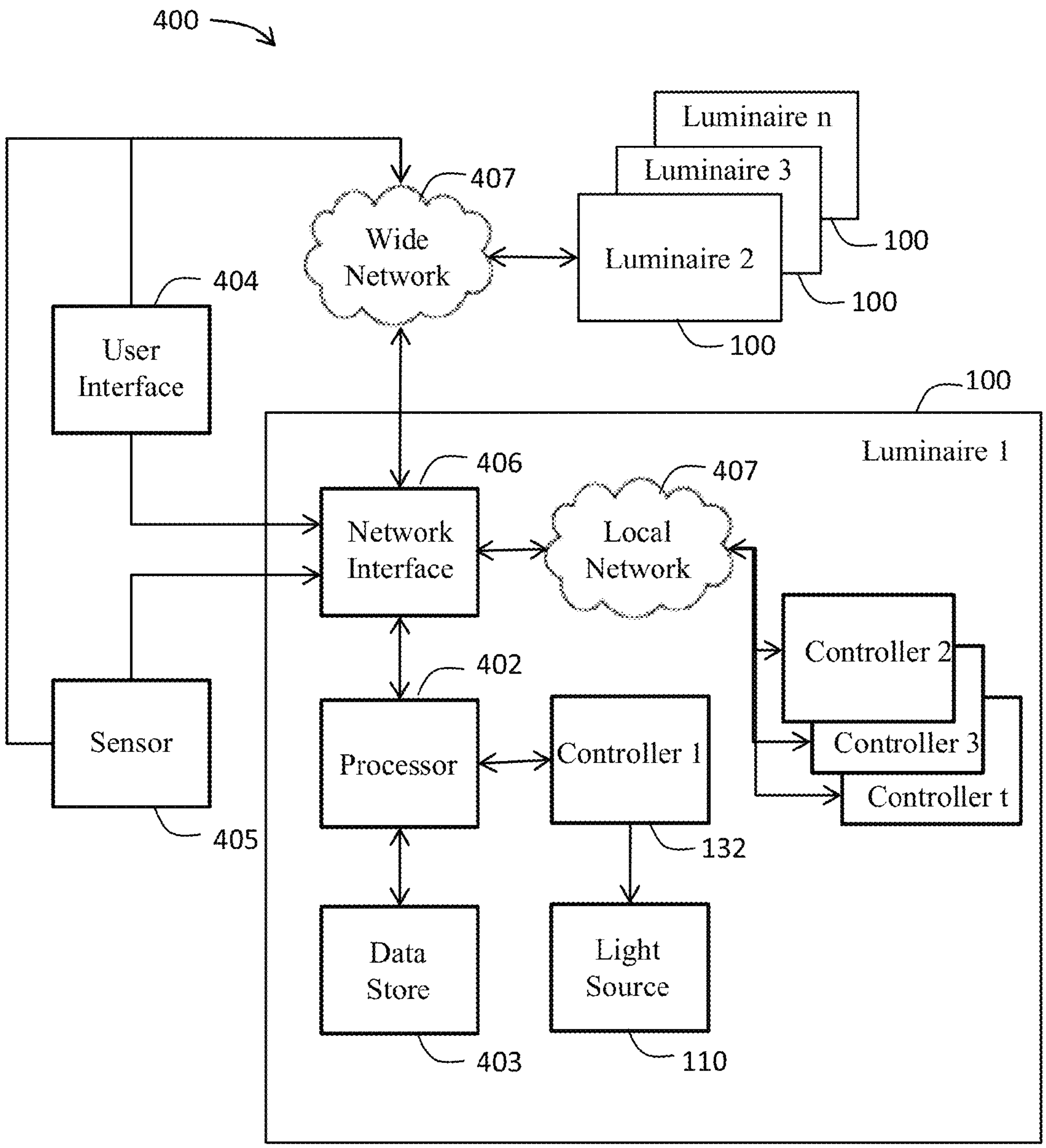


FIG. 3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Controller 3
Controller t
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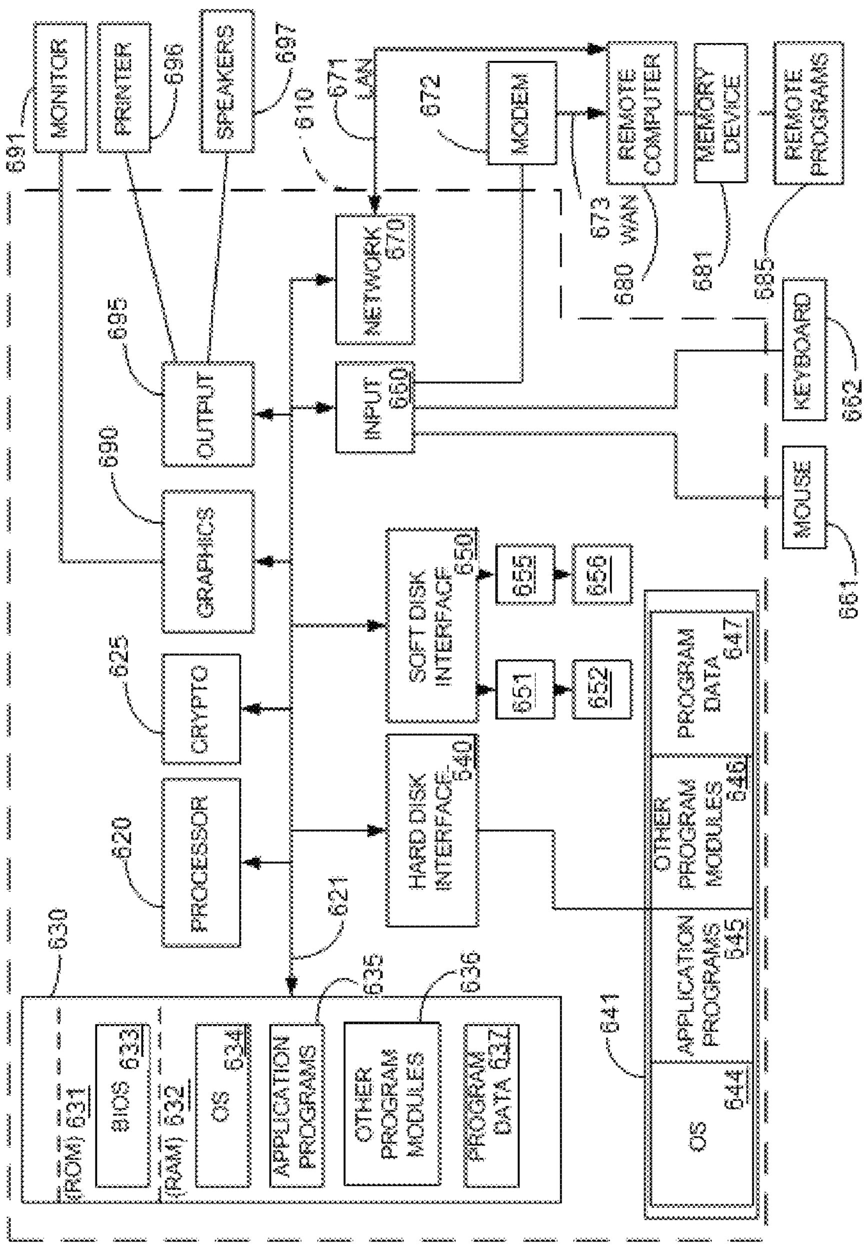
Sensor
Processor
Controller 1
405
132
Data Store
Light Source
403
110

FIG. 4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KEYBOARD
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GRAPHICS
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MOUSE
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PROGRAM DATA 637
641
OS 644
APPLICATION PROGRAMS 545
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PROGRAM DATA 647

FIG. 5

TROUGH LUMINAIRE WITH MAGNETIC LIGHTING DEVICES AND ASSOCIATED SYSTEMS AND METHODS

RELATED APPLICATIONS

This application is a continuation in part of U.S. patent application Ser. No. 13/832,969 titled Magnetically-Mountable Lighting Device and Associated Systems and Methods, filed simultaneously herewith, the entire contents of which are incorporated herein by reference. This application is also related to U.S. patent application Ser. No. 13/608,999 filed on Sep. 10, 2012 and titled System for Inductively Powering and Electrical Device and Associated Methods, the entire contents of which are incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to low profile luminaires and, more specifically, to luminaires used to replace legacy lamps in troffer-type light fixtures, and associated systems and methods.

BACKGROUND OF THE INVENTION

A fluorescent lamp (also called a fluorescent tube) uses electrical current to excite a vapor within a glass tube resulting in the discharge of electrons. Visible light is produced when the electrons cause a material coating the inner wall of the glass tube to fluoresce. Linear fluorescent lamps are routinely used in commercial or institutional buildings, and are commonly installed in troffer light fixtures (recessed troughs installed in a ceiling) and pendant light fixtures (housings suspended from a ceiling by a chain or pipe).

Fluorescent lamps have been steadily replacing incandescent lamps in many lighting applications. Compared to an incandescent lamp, a fluorescent lamp converts electrical power into useful light more efficiently, delivers a significantly longer useful life, and presents a more diffuse and physically larger light source. However, fluorescent lamp technology has disadvantages. A fluorescent lamp is typically more expensive to install and operate than an incandescent lamp because the fluorescent lamp requires a ballast to regulate the electrical current. Fluorescent light fixtures cannot be connected directly to dimmer switches intended for incandescent lamps, but instead require a compatible dimming ballast. The performance of fluorescent lamps may be negatively impacted by environmental conditions such as frequent switching and operating temperatures. Many fluorescent lamps have poor color temperature, resulting in a less aesthetically pleasing light. Some fluorescent lamps are characterized by prolonged warm-up times, requiring up to three minutes before maximum light output is achieved. Also, if a fluorescent lamp that uses mercury vapor is broken, a small amount of mercury (classified as hazardous waste) can contaminate the surrounding environment.

Digital lighting technologies such as light-emitting diodes (LEDs) offer significant advantages over traditional linear fluorescent lamps. These include but are not limited to better lighting quality, longer operating life, and lower energy consumption. Increasingly, LEDs are being designed to have desirable color temperatures. Moreover, LEDs do not contain mercury. Consequently, a market exists for LED-based retrofit alternatives to legacy lighting fixtures that use fluorescent lamps. However, a number of installation challenges and costs are associated with replacing linear fluorescent lamps with LED illumination devices. The challenges, which are

understood by those skilled in the art, include light output, thermal management, and ease of installation. The costs, which are similarly understood by those skilled in the art, typically stem from a need to replace or reconfigure a troffer or pendant fixture configured to support fluorescent lamps to support LEDs instead.

Retrofitting legacy lighting systems with digital lighting technology also introduces installation challenges. For example, by the very nature of their design and operation, LEDs have a directional light output. Consequently, employing LEDs to produce light distribution properties approximating or equaling the light dispersion properties of traditional lamps may require the costly and labor-intensive replacement or reconfiguration of the host light fixture, and/or the expensive and complexity-introducing design of LED-based solutions that minimize the installation impact to the host light fixture. Often material and manufacturing costs are lost in this trade off.

Another challenge inherent to operating LEDs is heat. Thermal management describes a system's ability to draw heat away from the LED, either passively or actively. LEDs suffer damage and decreased performance when operating in high-heat environments. Moreover, when operating in a confined environment, the heat generated by an LED and its attending circuitry itself can cause damage to the LED. Heat sinks are well known in the art and have been effectively used to provide cooling capacity, thus maintaining an LED-based light bulb within a desirable operating temperature. However, heat sinks can sometimes negatively impact the light distribution properties of the light fixture, resulting in non-uniform distribution of light about the fixture.

Power supply requirements of LED-based lighting systems can complicate installation of LEDs as a retrofit to existing light fixtures. LEDs are low-voltage light sources that require constant DC voltage or current to operate optimally, and therefore must be carefully regulated. Too little current and voltage may result in little or no light. Too much current and voltage can damage the light-emitting junction of the LED. LEDs are commonly supplemented with individual power adapters to convert AC power to the proper DC voltage, and to regulate the current flowing through during operation to protect the LEDs from line-voltage fluctuations.

A need exists for a troffer-retrofit luminaire that may be employed within the volume of space available in an existing troffer and pendant light fixture, and that delivers improved lighting quality compared to traditional LED troffers. More specifically, a need exists for a troffer-based lighting solution that benefits from the advantages of digital lighting technology, while exhibiting better cut-off and reduced glare than legacy troffer solutions. Additionally, a need exists for a luminaire designed for ease of installation as well as for manufacturing cost reduction. The lighting industry is experiencing advancements in LED applications, some of which may be pertinent to certain aspects of replacing linear fluorescent lamps. U.S. Pat. No. 8,348,492 to Mier-Langner et al. discloses an LED-based luminaire that attaches to a track through magnetic connectors rather than mechanical attachment mechanisms. Multiple puck-shaped luminaires may be mechanically coupled to a non-energized support bar portion of the track, and may be electrically coupled to an electrical conductor portion of the track. However, positioning of the luminaire pucks for lighting effect is limited by the fixed, longitudinal configuration of the track, as well as by reliance on a remote power supply to provide power to each of the luminaires.

U.S. Pat. No. 8,227,813 to Ward discloses an LED-based lighting device for replacing legacy light sources in an existing light fixture having an enclosure that includes a ferromagnetic material. The LEDs are bonded to a heat-conducting substrate that includes a ferromagnetic material that magnetically bonds to the existing light fixture enclosure with sufficient force to carry the light module. However, like the Mier-Langner solution, the Ward design limits positioning of the light sources to the configuration of the substrate, and tethers the light sources to electrical conductors connected to a remote power supply.

This background information is provided to reveal information believed by the applicant to be of possible relevance to the present invention. No admission is necessarily intended, nor should be construed, that any of the preceding information constitutes prior art against the present invention.

SUMMARY OF THE INVENTION

With the foregoing in mind, embodiments of the present invention are related to a luminaire adapted to be carried by a lighting fixture. The luminaire may include a plurality of lighting devices and a housing. The housing of the luminaire may be configured to be employed advantageously within the volume of space available in standard troffer lighting fixture. The lighting devices may advantageously deliver improved lighting quality compared to legacy lamps. Additionally, the luminaire may advantageously reduce the cost to manufacture and install a legacy lamp retrofit while maintaining flexibility to reconfigure the luminaire in the field.

Each of the plurality of lighting devices may comprise a heat sink and a light source. The lighting devices may comprise a first set of light sources that may emit light having a first color, and a second set of light sources that may emit light having a second color. Each light source may be in thermal communication with the thermally conductive heat sink. The housing may comprise a thermally conductive material such that the combined surface area of the respective heat sink of each of the lighting devices and of the housing may be proportional to a thermal output of the lighting devices.

The generally concave elongate-shaped housing may have an outer surface and an inner surface. The inner surface may define an optical chamber and a substantially polygonal aperture. Each of the plurality of lighting devices may be positioned adjacent to and spaced apart about the inner surface of the housing such that light emitted by the light source of each of the lighting devices may enter the optical chamber and pass through the aperture. The luminaire may further comprise a reflective primary optic positioned within the inner surface of the housing such that the light emitted by each light source may be reflected by the optic through the aperture.

Each of the plurality of lighting devices also may comprise a magnetic attachment member to which its heat sink and the light source may be coupled. The magnetic attachment member may be configured to magnetically bind to a ferromagnetic material. A magnetic bond between the magnetic attachment member of each lighting device and a ferromagnetic material positioned along the inner surface of the housing may be of sufficient force to carry each of the lighting devices during normal operation.

The housing may include pads molded into the inner surface such that each pad is configured to receive a respective lighting device. The pads may be disposed in a geometric pattern about the inner surface of the housing. Each of the lighting devices may be oriented substantially tangential to a point at which the device contacts the inner surface of the housing. The light emitted by the light source of each lighting device may pass through the aperture in a generally orthogonal direction in relation to the orientation of the device.

The luminaire may comprise one or more power supply units. Each power supply unit may be of an external type or an on-board type.

An on-board power supply unit may be operatively coupled to the light source and coupled to the magnetic attachment member. The on-board power supply unit may comprise at least one of a converter configured to convert an AC input voltage to a DC output voltage, and a regulator configured to sustain a DC output voltage within a target DC bias range.

An external power supply unit may be carried by the housing adjacent the outer surface. Each external power supply unit may be electrically connected to one or more of the pads using either inductive coupling or conductive coupling.

In an inductive coupling electrical connection, each of the pads may comprise a transmitter coil configured to transmit a desired voltage to a receiver coil on each of the plurality of lighting devices. The voltage may be either AC or DC. In a conductive coupling electrical connection, each of the pads may comprise a plurality of electrical contacts made of an electrically conductive material. A positive contact and a negative contact may be configured to transmit a DC voltage to a lighting device. A neutral contact and a live contact may be configured to transmit an AC voltage to a lighting device.

The luminaire may have a controller operably coupled to the plurality of lighting devices and configured to selectively operate each light source of the lighting devices. The luminaire may have an occupancy sensor configured to determine whether an object is within the field of view of the occupancy sensor. The occupancy sensor is configured to transmit a positive indication when an object is determined to be within the field of view. The controller may selectively operate light sources to illuminate the field of view upon receiving the positive indication.

The luminaire may comprise a network interface, and may be included in a lighting system having at least one network. The network interface may receive communications across the network and may provide instruction to the controller. The controller may selectively operate light sources responsive to the instruction received from the network interface.

A network may be a local network configured to enable data communication among a plurality of controllers within a given luminaire. Alternatively, or in addition, a network may be a wide network configured to enable data communication among the controllers of a plurality of luminaires.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A is an assembled, perspective view of a luminaire according to an embodiment of the present invention.

FIG. **1**B is an assembled, cross-sectional view of the luminaire illustrated in FIG. **1**A and taken through line **1**B-**1**B of FIG. **1**A.

FIG. **2**A is an assembled, perspective view of a magnetically-mountable lighting device of the luminaire illustrated in FIG. **1**A.

FIG. **2**B is an assembled, front elevation view of the magnetically-mountable lighting device illustrated in FIG. **2**A.

FIG. **2**C is an assembled, cross-sectional view of the magnetically-mountable lighting device illustrated in FIG. **2**A and taken through line **2**C-**2**C of FIG. **2**B.

FIG. **2**D is an exploded perspective view of the magnetically-mountable lighting device illustrated in FIG. **2**A.

FIG. **3** is a perspective view of a component assembly of the magnetically-mountable lighting device illustrated in FIG. **2**A.

FIG. **4** is a schematic block diagram of a lighting system according to an embodiment of the present invention.

FIG. **5** is a block diagram representation of a machine in the example form of a computer system according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Those of ordinary skill in the art realize that the following descriptions of the embodiments of the present invention are illustrative and are not intended to be limiting in any way. Other embodiments of the present invention will readily suggest themselves to such skilled persons having the benefit of this disclosure.

Although the following detailed description contains many specifics for the purposes of illustration, anyone of ordinary skill in the art will appreciate that many variations and alterations to the following details are within the scope of the invention. Accordingly, the following embodiments of the invention are set forth without any loss of generality to, and without imposing limitations upon, the claimed invention.

In this detailed description of the present invention, a person skilled in the art should note that directional terms, such as "above," "below," "upper," "lower," and other like terms are used for the convenience of the reader in reference to the drawings. Also, a person skilled in the art should notice this description may contain other terminology to convey position, orientation, and direction without departing from the principles of the present invention. Like numbers refer to like elements throughout.

Referring now to FIGS. **1-5**, a trough elongate low profile luminaire with magnetic lighting devices **100** according to an embodiment of the present invention is now described in detail. Throughout this disclosure, the present invention may be referred to as a luminaire **100**, a lighting system, an LED lighting system, a lamp system, a lamp, a system, a product, and a method. Those skilled in the art will appreciate that this terminology is only illustrative and does not affect the scope of the invention. For instance, the present invention may just as easily relate to lasers or other digital lighting technologies.

Example systems and methods for a trough low profile luminaire are described herein below. In the following description, for purposes of explanation, numerous specific details are set forth to provide a thorough understanding of example embodiments. It will be evident, however, to one of ordinary skill in the art that the present invention may be practiced without these specific details and/or with different combinations of the details than are given here. Thus, specific embodiments are given for the purpose of simplified explanation and not limitation.

Referring now, more specifically, to FIGS. **1**A and **1**B, a luminaire **100** according to an embodiment of the present invention will now be discussed. For purposes of definition, the term magnetically-mountable refers to adaptation to be carried through magnetic binding to a ferromagnetic material. Referring more specifically to FIGS. **1**A and **1**B, and additionally to FIG. **2**A, the luminaire **100**, according to an embodiment of the present invention, may include a plurality of lighting devices **110** and a housing **120**.

The luminaire **100** and its constituent components may be configured to permit the luminaire **100** to be positioned at least partially within and attached to a light fixture such that the luminaire **100** may be carried by the light fixture. In the present embodiment, the luminaire **100** may be configured to be positioned partially within and attached to a can-light lighting fixture. The components comprising the luminaire **100** may be connected by any means known in the art, including, not by limitation, use of adhesives or glues, welding, interference fit, and fasteners. Alternatively, one or more components of the luminaire **100** may be molded during manufacturing as an integral part of the luminaire **100**. An embodiment of the invention, as shown and described by the various figures and accompanying text, provides a luminaire configured to be carried by a light fixture.

Referring now to FIGS. **2**A, **2**B, **2**C, and **2**D, a magnetically-mountable lighting device **110** will now be discussed. Additional information directed to the components of the magnetically-mountable lighting device **110**, and associated systems and methods, is found in U.S. patent application Ser. No. 13/832,969 titled Magnetically-Mountable Lighting Device and Associated Systems and Methods, filed simultaneously herewith, the entire contents of which are incorporated herein by reference.

Referring more specifically to FIGS. **2**C and **2**D, the lighting device **110**, according to an embodiment of the present invention, may include a heat generating element **210**, a heat sink **220**, a power source **230**, a magnetic attachment member **240**, an enclosure **260**, and an optic **270**. The heat generating element **210** may be in the form of a light source. For example, and without limitation, the assembled configuration of the lighting device **110** may present a puck-like shape, defined as generally cylindrical and having a cylinder height that is less than the cylinder width.

Referring more specifically to FIG. **2**D, the heat sink **220** of the lighting device **110**, according to an embodiment of the present invention, is discussed in greater detail. Thermal management capability of the lighting device **110** according to an embodiment of the present invention may be provided by one or more heat sinks **220**. More specifically, the heat sink **220** may be configured to be thermally coupled to elements of the lighting device **110** so as to increase the thermal dissipation capacity of the lighting device **110**. The heat sink **220** may include a number of fins **222** configured to provide a larger surface area than may otherwise be provided by the surface of the light source **210**. The configuration of the fins **222** may be according to the direction of the incorporated references. For example, and without limitation, portions of a heat sink **220** may include one or more fins **222** that may be coupled with and positioned substantially perpendicular to a base portion **224**.

Continuing to refer to FIGS. **2**C and **2**D, the light source **210** of the lighting device **110** according to an embodiment of the present invention is now discussed in greater detail. The heat sink **220** may be positioned adjacent to and in thermal communication with the light source **210**. The light source **210** may comprise one or more light emitting elements **212** which may, for example and without limitation, include light-emitting semiconductors, such as light-emitting diodes (LEDs), lasers, incandescent, halogens, arc-lighting devices, fluorescents, and any other digital light-emitting device known in the art. The light source **210** may include a first and second set of light emitting elements **212** each configured to emit at wavelengths different than each other. In some embodiments of the present invention, the light source **110** may be an LED package. Additional information directed to the use of heat sinks for dissipating heat in an illumination apparatus is found in U.S. Pat. No. 7,922,356 titled Illumination Apparatus for Conducting and Dissipating Heat from a Light Source, and U.S. Pat. No. 7,824,075 titled Method and Apparatus for Cooling a Light Bulb, the entire contents of each of which are incorporated herein by reference.

Referring additionally to FIG. **3**, and continuing to refer to FIGS. **2**C and **2**D, the power source **230** of the lighting device **110**, according to an embodiment of the present invention, is discussed in greater detail. The power source **230** may be mounted on a component assembly **250** circuit board and may be operably coupled with the light source **210**. For example, and without limitation, the power source **230** may be in the form of an on-board power supply unit configured to deliver electrical power to the LEDs **210**. The on-board power supply unit **230** may have a converter **310** that may convert an AC input voltage to a DC output voltage. The on-board power supply unit **230** also may have a regulator **312** that may sustain a DC output voltage within a target DC bias range.

In one embodiment, the on-board power supply unit **230** may have at least one induction coil (not shown) configured to receive an AC input voltage through inductive coupling. In another embodiment, the on-board power supply unit **230** may have at least one wire connector configured to receive the AC input voltage through conductive coupling. Alternatively, the power supply unit **230** may be in the form of at least one power terminal (not shown) that receives power from a source external to the lighting device **110**, and transmits that electrical power to the light source **210** and/or other electronic components comprising the component assembly **250**.

The luminaire may comprise one or more power supply units. Each power supply unit may be of an external type or an on-board type. An on-board power supply unit may be operatively coupled to the light source and coupled to the magnetic attachment member. The on-board power supply unit may comprise at least one of a converter configured to convert an AC input voltage to a DC output voltage, and a regulator configured to sustain a DC output voltage within a target DC bias range.

An external power supply unit may be carried by the housing adjacent the outer surface. Each external power supply unit may be electrically connected to one or more of the pads using either inductive coupling or conductive coupling. In an inductive coupling electrical connection, each of the pads may comprise a transmitter coil configured to transmit a desired voltage to a receiver coil on each of the plurality of lighting devices. The voltage may be either AC or DC.

In a conductive coupling electrical connection, each of the pads may comprise a plurality of electrical contacts made of an electrically conductive material. A positive contact and a negative contact may be configured to transmit a DC voltage to a lighting device. A neutral contact and a live contact may be configured to transmit an AC voltage to a lighting device. Additional information directed to the use of inductive coupling is found in U.S. patent application Ser. No. 13/608,999 titled System for Inductively Powering an Electrical Device and Associated Methods, the entire contents of which are incorporated herein by reference.

Referring again to FIGS. **2**A, **2**B, **2**C, and **2**D, the enclosure **260** of the lighting device **110** according to an embodiment of the present invention will now be discussed in greater detail. The enclosure **260** may include a mounting base **262** and a sidewall **264** portion that may combine to define an interior volume known as a cavity **266**. The cavity **266** may be configured to contain one or more of the light source **210**, the heat sink **220**, the power supply **230** and other components comprising the component assembly **250**, and the magnetic attachment member **240**.

Continuing to refer to FIGS. **2**C and **2**D, the magnetic attachment member **240** of the present embodiment will now be discussed in greater detail. The magnetic attachment member **240** may be used to fixedly or detachably mount a lighting device **110** to a ferromagnetic surface external to the lighting device **110**. For example, and without limitation, the magnetic attachment member **240** may comprise a permanent magnet sized and shaped to be disposed within the cavity **266** of the enclosure **260** generally adjacent to the mounting base **262**. As illustrated in FIG. **2**D, for example, and without limitation, the magnetic attachment member **240** may have a generally annular shape allowing for a proximate fit to the mounting base **262**. Such a configuration may position the magnetic attachment member **240** to provide mechanical support to the lighting device **110** by applying an upward force on the mounting base **262**. More specifically, carrying force may be created in a direction of a ferromagnetic material external to the enclosure **260** of the lighting device **110** that may be brought into the magnetic field of the magnetic attachment member **240**. The heat sink, the light source, and the power source may be mechanically coupled to the magnetic attachment member, and thereby carried by the magnetic attachment member when the lighting device is magnetically mounted to a external ferromagnetic material.

Continuing to refer to FIGS. **2**A, **2**B, **2**C, and **2**D, the optic **270** of the lighting device **110** according to an embodiment of the present invention will now be discussed in greater detail. The optic **270** may be attached to the enclosure **260** so as to define an optical chamber **272** into which light emitted by the light source **210** may enter and subsequently pass through the optic **270**. The optic **270** may be configured to interact with light emitted by the light source **210** to refract incident light. Accordingly, the light source **210** may be disposed such that light emitted therefrom is incident upon the optic **270**. The optic **270** may be formed in any shape to impart a desired refraction. Additionally, the optic **270** may be configured to generally diffuse light incident thereupon.

Referring again to FIGS. **1**A and **1**B, the housing **120** of the luminaire **100** according to an embodiment of the present invention is now discussed in greater detail.

The housing **120** may comprise an outer surface **123**, an inner surface **104**, and an electronics housing member **130**. The electronics housing member **130** may be positioned adjacent the outer surface **123** of the housing **200** and positioned to facilitate establishment of an electrical connection between electronic components within the electronics housing member **130** and electrical devices of the luminaire **100**, such as the lighting devices **110**. For example, and without limitation, electrical conductor channels **125** may house electrical conductors spanning the distance from the electronic components to the respective lighting devices **110**. The housing **120** may include one or more attachment sections **143**. The attachment sections **143** may be configured to be at a lower end of the housing **120**. For example, and without limitation, the attachment sections **143** may include optic attachment structures and/or luminaire mounting structures.

The housing **120** may be configured into a three-dimensional geometric shape so as to control the direction of light emitted from the lighting devices **110**. For example, and without limitation, the housing **120** may have a generally concave elongate-shape defining an optical chamber **108** and a substantially polygonal aperture **102**. As shown in FIG. **1**B, the housing **120** may be configured to orient lighting devices **110** positioned thereupon such that light emitted from each lighting device **110** may be directed to propagate light through the aperture **102**. More specifically, each of the plurality of lighting devices **110** may be positioned adjacent to and spaced apart about the inner surface **104** of the housing such that light emitted by the light source of each of the lighting devices may enter the optical chamber **108** and pass through the aperture. The housing **120** may comprise a ferromagnetic material adjacent the inner surface **104**, which may cause the magnetic attachment member **240** in the lighting devices **110** to create a carrying force necessary to magnetically attach the lighting devices to the housing **120**.

While the current embodiment has specific structural features, it is contemplated and within the scope of the invention that the method of indirect lighting disclosed above may be applied to luminaires **100** having different structural features For example, and without limitation, the use of an optical chamber, such as the optical chamber **108** of the present embodiment, may be included in the alternative form factors, as well as a color conversion layer so as to achieve desirable characteristics of light emitted by the luminaire. The positioning of the light sources **110** and the light-emitting elements **210** may take into account the direction that light emitted therefrom will propagate, as well as any other element or structure of the luminaire **100** with which it may be incident and may interact. Specifically, the light sources **110** and plurality of light-emitting elements **210** may be positioned to take into account the incidence of emitted light upon the reflective inner surface **108** and the reflection of the light therefrom. Furthermore, due to the shape of the reflective inner surface **108**, the incidence of light emitted from individual light-emitting elements **210** from a certain position may result in light being reflected from the reflective inner surface **108** and propagating therefrom in a predictive direction. As described hereinabove, light reflected from the reflective inner surface **108** may propagate into the environment surrounding the luminaire **100** through the aperture **103**.

Accordingly, the light-emitting elements **210** may be positioned such that light emitted from each of the plurality of light-emitting elements may propagate through the aperture **103** and into the environment surrounding the luminaire **100** in a predictive direction. For example, the light emitted from a light-emitting element may be reflected by the reflective inner surface **108** and propagate through the aperture in a direction that is generally radially opposite the radial direction of the light-emitting element **210** relative to a longitudinal axis of the luminaire **100**. Additionally, where the plurality of light-emitting elements **210** are positioned in a distributed configuration, as depicted in FIG. **1**B, each of the light-emitting elements **210** may be selectively operated to redirect the balance of light produced from luminaire **100**.

For example, where all of the plurality of light-emitting elements **210** are operated, the light produced by the luminaire **100** may be generally equally distributed about the environment external the luminaire **100**, the environment generally defined as a hemisphere beneath the aperture **103**. Where only subsets or individual light-emitting elements **210** are selectively operated, the light produced by the luminaire **100** may be unevenly distributed about the environment external the luminaire **100**, such as being distributed more to one side than another, or to form a staggered pattern of lighting. All distributions of light produced by the luminaire **100** into the environment surrounding the luminaire **100** are contemplated and included within the scope of the invention.

Each of the light-emitting elements **210** may emit light within a wavelength range. More specifically, each of the light-emitting elements may emit light having a wavelength range within the wavelength range from about 390 nanometers to about 750 nanometers, commonly referred to as the visible spectrum. Each of the light-emitting elements **210** may emit light having a wavelength range identical or similar to the wavelength range to another of the light-emitting elements **210**, or it may emit light having a wavelength range different from another of the light-emitting elements **210**.

The selection of light-emitting elements **210** included in the light source **110** may be made so as to produce a desirous combined light, as described hereinabove. Accordingly, the light source **110** may include light-emitting elements **210** that produce light having a variety of wavelengths such that the emitted light combines in the optical chamber **108** to form a combined polychromatic light. In some embodiments, the combined light may be observed by an observer in the environment external the luminaire **100** as a generally white light. Moreover, the combined light may have desirous characteristics, such as certain color temperatures and color rendering indices. The methods of forming such a combined light are discussed in the references incorporated by reference hereinabove. For example, the light source **110** may include light-emitting elements **210** that emit light that combines to produce a combined light that is generally white in color or any other color such as those represented on the 1931 CIE color space, having a color temperature within the range from about 2,000 Kelvin to about 25,000 Kelvin, and/or having a coloring rendering index within the range from about 15 to about 100. Moreover, in addition to including light-emitting elements **210** to produce a combined light having desirous characteristics, the luminaire **100** may include one or more color conversion layers configured to convert light from a first source wavelength to a second converted wavelength as described in greater detail hereinabove and hereinbelow.

Referring again to FIGS. **1**A and **1**B, a body member **140** may be configured to define an aperture **103**. The aperture **103** may be a void formed by the body member **140** somewhere within the periphery of the body member **140**. In the present embodiment, the aperture **103** may be formed approximately at the center of the body member **140**. Furthermore, the aperture **103** may be configured into any geometric configuration. In the present embodiment, the aperture **103** is generally polygonal. More specifically, the aperture **103** may be formed into a generally rectangular configuration. This embodiment is exemplary only, and the aperture **103** may be formed into any other geometric configuration, including, without limitations, ovals, semicircles, triangles, squares, and any other polygon.

The aperture **103** may be configured so as to cooperate with the aperture of the primary optic **102** to permit light that traverses through the aperture of the primary optic **102** to similarly traverse the aperture **103** and to propagate into the environment surrounding the luminaire **100**.

The body member **140** may be formed into any geometric configuration. In the present embodiment, the body member **140** is formed into a generally rectangular configuration. More specifically, the body member **140** may be formed into a polygonal configuration. Additionally, due to the positioning of the aperture **103** at the center of the body member **140** and the aperture **103** being configured as a circle, the body member **140** may be described as a ring. This embodiment is exemplary only, and the body member **140** may be formed into any other geometric configuration, including, without limitations, ovals, semicircles, triangles, squares, and any other polygon, with the aperture **103** being formed somewhere within the periphery of the geometric configuration employed. Moreover, the body member **140** and the aperture **103** may be selectively formed into identical, similar, or entirely different geometric configurations. In forming each of the body member **140** and the aperture **103**, the geometric configuration of a light fixture in which the luminaire **100** may be disposed may be considered.

The body member **140** may be formed of a thermally conductive material. Forming the body member **140** of thermally conductive material may increase the thermal dissipation capacity of the heat sinks **220** of the lighting devices **110** as well as the luminaire **100** generally. Examples of thermally conductive materials include metals, metal alloys, ceramics, and thermally conductive polymers, such as CoolPoly® and Therma-Tech™. This list is not exhaustive, and all other thermally conductive materials are contemplated and within the scope of the invention.

The housing **120** may include a primary optic **102** positioned adjacent to the optical chamber **108** of the housing **120**. More specifically, the primary optic **102** may be positioned so as to interface with an inner surface **104** of the housing **120**. The primary optic **102** may include a reflective inner surface **106**. The reflective inner surface **106** may be configured to reflect light incident thereupon. More specifically, the reflective inner surface **106** may be configured to reflect a light incident thereupon such that the reflected light has an intensity of at least 95% of the intensity of the light before being reflected.

The reflective inner surface **106** of the primary optic **102** may be configured to be reflective by any method known in the art. For example, and without limitation, the primary optic **102** may be formed of a material that is inherently reflective of light, and therefore the inner surface inherently would be reflective. As another example, the primary optic **102** may be formed of a material that may be polished to become reflective. As yet another example, the primary optic **102**, or at least an inner surface of the primary optic **102**, may be formed of a material that is permissive of a material being coated, attached, or otherwise disposed thereupon, the disposed material being reflective. These methods of forming the reflective inner surface **106** are exemplary only and do not serve to limit the scope of the invention. All methods known in the art of forming a reflective surface are contemplated and included within the scope of the invention.

The reflective inner surface **106** may have an efficiency associated with it. More specifically, the reflective inner surface **106** may reflect light incident thereupon at a percentage of the intensity of the incident light. For example, the reflective inner surface **106** may reflect incident light at least at about least 95% of the original intensity. The reflective inner surface **106** may be configured to reflect incident light within an intensity range from about 80% to about 99% of the original intensity.

Additionally, the reflective inner surface **106** may include a color conversion layer. The color conversion layer may be configured to receive a source light having a first wavelength, and to convert the wavelength of source light to a second wavelength, defined as a converted light. The color conversion layer may be constructed of material selected from the group consisting of phosphors, quantum dots, luminescent materials, fluorescent materials, and dyes. More details regarding the enablement and use of a color conversion layer may be found in U.S. patent application Ser. No. 13/073,805, entitled MEMS Wavelength Converting Lighting Device and Associated Methods, filed Mar. 28, 2011, as well as U.S. patent application Ser. No. 13/234,604, entitled Remote Light Wavelength Conversion Device and Associated Methods, filed Sep. 16, 2011, U.S. patent application Ser. No. 13/234,371, entitled Color Conversion Occlusion and Associated Methods, filed Sep. 16, 2011, and U.S. patent application Ser. No. 13/357,283, entitled Dual Characteristic Color Conversion Enclosure and Associated Methods, the entire contents of each of which are incorporated herein by reference.

Additionally, the reflective inner surface **106** may include two or more color conversion layers, wherein each color conversion layer is positioned upon different sections of the reflective inner surface **106**. Each of the two or more color conversion layers may convert respective source lights of differing wavelengths to respective converted lights of differing wavelengths. The reflective inner surface **106** may include any number of color conversion layers in any configuration, including overlapping layers.

The primary optic **102** may be configured into any shape. As depicted in FIG. **1**B, the primary optic **102** may be configured into a three-dimensional geometric shape. More specifically, the primary optic **102** may be configured into a generally curved shape. In the present embodiment, the primary optic **102** may be configured into a generally domed concave elongate shape. Many other shapes of the primary optic **102** are contemplated and included within the scope of the invention, including, without limitation, spherical, conical, cylindrical, parabolic, pyramidal, and any other geometric configuration that may reflect light.

The primary optic **102** may at least partially define an optical chamber **108**. In the present embodiment, the primary optic **102** may define an upper portion of the optical chamber **108** that is generally concave elongate, extending upward in the direction of the housing **110**. Light that traverses the optical chamber **108** and is incident upon the reflective inner surface **106** may be reflected back into the optical chamber **108** by the reflective inner surface **106**. The optical chamber **108** may be configured so as to permit light that propagates through the optical chamber **108** to combine, forming a combined light. The combined light may be a polychromatic light, having multiple constituent wavelengths of light. In some embodiments, the combined light may be a white light. Additional information regarding color combination may be found in U.S. patent application Ser. No. 13/107,928, entitled High Efficacy Lighting Signal Converter and Associated Methods, filed May 15, 2011, as well as U.S. Patent Application Ser. No. 61/643,308, entitled Tunable Light System and Associated Methods, filed May 6, 2012, the entire contents of each of which are incorporated by reference herein.

The primary optic **102** may be configured to have an open end, thereby defining an aperture. The aperture may be configured to permit light traversing the optical chamber **108** to pass therethrough. Furthermore, the aperture may cooperate with additional structures of the luminaire **110** to permit the traversal of light from the optical chamber **108** to the environment.

Like the housing **120** itself, the primary optic **102** may be configured into a three-dimensional geometric shape so as to control the direction of light reflected from the reflective inner surface **106**. For example, the primary optic **102** may be configured to reflect light incident thereupon such that the light is reflected to propagate through the aperture of the primary optic **102**.

Continuing to refer to FIG. **1**B, the housing **120** may come into thermal contact with the lighting devices **110** so as to participate in thermal management for the luminaire **110**. For example, and without limitation, the housing **120** may comprise a thermally conductive material (as discussed above) such that the combined surface area of the respective heat sink **220** of each of the lighting devices **110** and of the housing **120** may be proportional to a thermal output of the lighting devices **110**.

The housing **120** may include **170** pads molded into the inner surface **104** such that each pad **170** is configured to receive a respective lighting device **110**. For example, and without limitation, the pads **170** may be disposed in a geometric pattern about the inner surface **104** of the housing. Each of the lighting devices **110** may be oriented substantially tangential to a point at which the device contacts the inner surface **104** of the housing **120**. The light emitted by the light source **220** of each lighting device **110** may pass through the aperture **103** in a generally orthogonal direction in relation to the orientation of the device **110**. This embodiment is exemplary only and all methods of removable attachment are contemplated and included within the scope of the invention.

Continuing to refer to FIG. **1**A, the mounting structures **143** may be distributed in a spaced configuration about the lower housing **120** and may be configured to engage with an existing can-light fixture (not shown). In the present embodiment, the mounting structures **143** are configured as clips. This embodiment is exemplary only and all methods of removable attachment are contemplated and included within the scope of the invention.

Referring now to FIG. **4**, the logical components of a lighting system **400** according to one embodiment of the present invention, may comprise a one or more luminaires **100**, each of which may include a controller **132** and the light source **110**. The controller **132** may be designed to control the characteristics of a source light emitted by the light source **110**. For example, and without limitation, the controller **132** may be configured to operate the light source **110** between operating and non-operating states, wherein the light source **110** emits light when operating, and does not emit light when not operating. The lighting device **110** also may comprise a processor **402** that may accept and execute computerized instructions, and also a data store **403** which may store data and instructions used by the processor **402**. More specifically, the processor **402** may be configured to receive the input transmitted from some number of input devices **404**, **405** and to direct that input to a data store **403** for storage and subsequent retrieval. For example, and without limitation, the processor **402** may be in data communication with the input device **404**, **405** through a direct connection and/or through a network interface **406**.

Referring additionally to FIG. **4**, where the light source **110** includes a plurality of light-emitting elements **210**, the controller **132** may be operably connected to the plurality of light emitting elements **210**. Furthermore, the controller **132** may be operably connected to the plurality of light-emitting elements **210** so as to selectively operate each of the plurality of light-emitting elements **210**. Accordingly, the controller **132** may be configured to operate the light-emitting elements **210** as described hereinabove. Moreover, the controller **132** may be configured to operate the light-emitting elements **210** so as to control the color, color temperature, and distribution of light produced by the luminaire **100** into the environment surrounding the luminaire **100** as described hereinabove.

In addition to selective operation of each of the plurality of light-emitting elements **210**, the controller **132** may be configured to operate each of the plurality of light-emitting elements **210** so as to cause each light-emitting element **510** to emit light either at a full intensity or a fraction thereof. Many methods of dimming, or reducing the intensity of light emitted by a light-emitting element, are known in the art. Where the light-emitting elements **210** are LEDs, the controller **132** may use any method of dimming known in the art, including, without limitation, pulse-width modulation (PWM) and pulse-duration modulation (PDM). This list is exemplary only and all other methods of dimming a light-emitting element is contemplated and within the scope of the invention. Further disclosure regarding PWM may be found in U.S. patent application Ser. No. 13/073,805, the entire contents of which are incorporated by reference hereinabove.

The luminaire may have an occupancy sensor configured to determine whether an object is within the field of view of the occupancy sensor. The occupancy sensor is configured to transmit a positive indication when an object is determined to be within the field of view. The controller may selectively operate light sources to illuminate the field of view upon receiving the positive indication.

In some embodiments, the luminaire **100** may further include a sensor **405**. The sensor **405** may be configured to affect the operation of the light source **110**. For example, the sensor **405** may be in electrical communication with a controller **132** as described hereinabove. The sensor **405** may transmit a signal to the controller **132** indicating that the controller **132** should either operate the light source **110** or cease operation of the light source **110**. For example, the sensor **405** may be an occupancy sensor that detects the presence of a person within a field of view of the occupancy sensor. When a person is detected, the occupancy sensor **405** may indicate to the controller **132** that the light source **110** should be operated so as to provide lighting for the detected person. Accordingly, the controller **132** may operate the light source **110** so as to provide lighting for the detected person.

Furthermore, the occupancy sensor **405** may either indicate that lighting is no longer required when a person is no longer detected, or either of the occupancy sensor or the controller **132** may indicate lighting is no longer required after a period of time transpires during which a person is not detected by the occupancy sensor. Accordingly, in either situation, the controller **132** may cease operation of the light source **110**, terminating lighting of the environment surrounding the luminaire **100**. The sensor **405** may be any sensor capable of detecting the presence or non-presence of a person in the environment surrounding the luminaire **100**, including, without limitation, infrared sensors, motion detectors, and any other sensor of similar function known in the art. More disclosure regarding motion-sensing luminaires and occupancy sensors may be found in U.S. patent application Ser. No. 13/403,531, entitled Configurable Environmental Sensing Luminaire, System and Associated Methods, filed Feb. 23, 2012, and U.S. patent application Ser. No. 13/464,345, entitled Occupancy Sensor and Associated Methods, filed May 4, 2012, the entire contents of both of which are herein incorporated by reference.

A network may be a local network **407** configured to enable data communication among a plurality of controllers within a given luminaire. Alternatively, or in addition, a network may be a wide network **406** configured to enable data communication among the controllers of a plurality of luminaires.

Additionally, the luminaire **100** may further include a network interface **406**. The network interface **406** may be configured to establish connection with a network **407** and communicate with other electronic devices similarly connected to the network **407** there across. Furthermore, the network interface **406** may be in communication with the various electronic components and devices of the luminaire **100**, thereby enabling the various electronic components and devices of the luminaire **100** to communicate with other electronic devices across the network **407**. For example, the network interface **406** may connect to a network of a plurality of luminaires **100** according to the present invention. Furthermore, the luminaire **100** may be configured to transmit and/or receive signals across the network **407** via the network interface **406** affecting the operation of light source **110**. For example, the luminaire **100**, or more specifically an electronic device of the luminaire, such as a controller **132**, may be placed in communication with the network interface **406** and receive a signal across the network **407** containing an instruction to either operate or cease operation of the light source **110**. The controller **132** may then operate the light source **110** responsive to the received signal. Furthermore, the controller **132** may similarly transmit a signal to other luminaires across the network **407** with a similar instruction to either operate or cease operation of the luminaires' respective light sources. More disclosure regarding networked lighting and attending luminaires may be found in U.S. patent application Ser. No. 13/463,020, entitled Wireless Pairing System and Associated Methods, filed May 3, 2012 and U.S. patent application Ser. No. 13/465,921, entitled Sustainable Outdoor Lighting System and Associated Methods, filed May 7, 2012, the entire contents of both of which are incorporated herein by reference.

A skilled artisan will note that one or more of the aspects of the present invention may be performed on a computing device. The skilled artisan will also note that a computing device may be understood to be any device having a processor, memory unit, input, and output. This may include, but is not intended to be limited to, cellular phones, smart phones, tablet computers, laptop computers, desktop computers, personal digital assistants, etc. FIG. **5** illustrates a model computing device in the form of a computer **610**, which is capable of performing one or more computer-implemented steps in practicing the method aspects of the present invention. Components of the computer **610** may include, but are not limited to, a processing unit **620**, a system memory **630**, and a system bus **621** that couples various system components including the system memory to the processing unit **620**. The system bus **621** may be any of several types of bus structures including a memory bus or memory controller, a peripheral bus, and a local bus using any of a variety of bus architectures. By way of example, and not limitation, such architectures include Industry Standard Architecture (ISA) bus, Micro Channel Architecture (MCA) bus, Enhanced ISA (EISA) bus, Video Electronics Standards Association (VESA) local bus, and Peripheral Component Interconnect (PCI).

The computer **610** may also include a cryptographic unit **625**. Briefly, the cryptographic unit **625** has a calculation function that may be used to verify digital signatures, calculate hashes, digitally sign hash values, and encrypt or decrypt data. The cryptographic unit **625** may also have a protected memory for storing keys and other secret data. In other embodiments, the functions of the cryptographic unit may be instantiated in software and run via the operating system.

A computer **610** typically includes a variety of computer readable media. Computer readable media can be any available media that can be accessed by a computer **610** and includes both volatile and nonvolatile media, removable and non-removable media. By way of example, and not limitation, computer readable media may include computer storage media and communication media. Computer storage media includes volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information such as computer readable instructions, data structures, program modules or other data. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, FLASH memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by a computer **610**. Communication media typically embodies computer readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, radio frequency, infrared and other wireless media. Combinations of any of the above should also be included within the scope of computer readable media.

The system memory **630** includes computer storage media in the form of volatile and/or nonvolatile memory such as read only memory (ROM) **631** and random access memory (RAM) **632**. A basic input/output system **633** (BIOS), containing the basic routines that help to transfer information between elements within computer **610**, such as during start-up, is typically stored in ROM **631**. RAM **632** typically contains data and/or program modules that are immediately accessible to and/or presently being operated on by processing unit **620**. By way of example, and not limitation, FIG. **5** illustrates an operating system (OS) **634**, application programs **635**, other program modules **636**, and program data **637**.

The computer **610** may also include other removable/non-removable, volatile/nonvolatile computer storage media. By way of example only, FIG. **5** illustrates a hard disk drive **641** that reads from or writes to non-removable, nonvolatile magnetic media, a magnetic disk drive **651** that reads from or writes to a removable, nonvolatile magnetic disk **652**, and an optical disk drive **655** that reads from or writes to a removable, nonvolatile optical disk **656** such as a CD ROM or other optical media. Other removable/non-removable, volatile/nonvolatile computer storage media that can be used in the exemplary operating environment include, but are not limited to, magnetic tape cassettes, flash memory cards, digital versatile disks, digital video tape, solid state RAM, solid state ROM, and the like. The hard disk drive **641** is typically connected to the system bus **621** through a non-removable memory interface such as interface **640**, and magnetic disk drive **651** and optical disk drive **655** are typically connected to the system bus **621** by a removable memory interface, such as interface **650**.

The drives, and their associated computer storage media discussed above and illustrated in FIG. **5**, provide storage of computer readable instructions, data structures, program modules and other data for the computer **610**. In FIG. **5**, for example, hard disk drive **641** is illustrated as storing an OS **644**, application programs **645**, other program modules **646**, and program data **647**. Note that these components can either be the same as or different from OS **633**, application programs **633**, other program modules **636**, and program data **637**. The OS **644**, application programs **645**, other program modules **646**, and program data **647** are given different numbers here to illustrate that, at a minimum, they may be different copies. A user may enter commands and information into the computer **610** through input devices such as a keyboard **662** and cursor control device **661**, commonly referred to as a mouse, trackball or touch pad. Other input devices (not shown) may include a microphone, joystick, game pad, satellite dish, scanner, or the like. These and other input devices are often connected to the processing unit **620** through a user input interface **660** that is coupled to the system bus, but may be connected by other interface and bus structures, such as a parallel port, game port or a universal serial bus (USB). A monitor **691** or other type of display device is also connected to the system bus **621** via an interface, such as a graphics controller **690**. In addition to the monitor, computers may also include other peripheral output devices such as speakers **697** and printer **696**, which may be connected through an output peripheral interface **695**.

The computer **610** may operate in a networked environment using logical connections to one or more remote computers, such as a remote computer **680**. The remote computer **680** may be a personal computer, a server, a router, a network PC, a peer device or other common network node, and typically includes many or all of the elements described above relative to the computer **610**, although only a memory storage device **681** has been illustrated in FIG. **5**. The logical connections depicted in FIG. **5** include a local area network (LAN) **671** and a wide area network (WAN) **673**, but may also include other networks **140**. Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets and the Internet.

When used in a LAN networking environment, the computer **610** is connected to the LAN **671** through a network interface or adapter **670**. When used in a WAN networking environment, the computer **610** typically includes a modem **672** or other means for establishing communications over the WAN **673**, such as the Internet. The modem **672**, which may be internal or external, may be connected to the system bus **621** via the user input interface **660**, or other appropriate mechanism. In a networked environment, program modules depicted relative to the computer **610**, or portions thereof, may be stored in the remote memory storage device. By way of example, and not limitation, FIG. **5** illustrates remote application programs **685** as residing on memory device **681**.

The communications connections **670** and **672** allow the device to communicate with other devices. The communications connections **670** and **672** are an example of communication media. The communication media typically embodies computer readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. A "modulated data signal" may be a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Computer readable media may include both storage media and communication media.

Some of the illustrative aspects of the present invention may be advantageous in solving the problems herein described and other problems not discussed which are discoverable by a skilled artisan. While the above description contains much specificity, these should not be construed as limitations on the scope of any embodiment, but as exemplifications of the presented embodiments thereof. Many other ramifications and variations are possible within the teachings of the various embodiments. While the invention has been described with reference to exemplary embodiments, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment disclosed as the best or only mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims. Also, in the drawings and the description, there have been disclosed exemplary embodiments of the invention and, although specific terms may have been employed, they are unless otherwise stated used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention therefore not being so limited. Moreover, the use of the terms first, second, etc. do not denote any order or importance, but rather the terms first, second, etc. are used to distinguish one element from another. Furthermore, the use of the terms a, an, etc. do not denote a limitation of quantity, but rather denote the presence of at least one of the referenced item.

Thus the scope of the invention should be determined by the appended claims and their legal equivalents, and not by the examples given.

What is claimed is:

1. A luminaire adapted to be carried by a light fixture comprising:

a generally concave elongate-shaped housing comprising a ferromagnetic material and having an outer surface and an inner surface opposite the outer surface, the inner surface defining an optical chamber and a substantially polygonal aperture; and

a plurality of lighting devices each comprising:

a heat sink,

a light source in thermal communication with the heat sink, and

a magnetic attachment member,

wherein the heat sink and the light source are coupled to the magnetic attachment member;

wherein the respective magnetic attachment member of each of the plurality of lighting devices is magnetically mountable to the ferromagnetic material such that the plurality of lighting devices are positionable adjacent to and spaced apart about the inner surface of the housing, and such that light emitted by the respective light source of each of the plurality of lighting devices enters the optical chamber and passes through the substantially polygonal aperture.

2. The luminaire according to claim **1** wherein an orientation of each of the plurality of lighting devices is substantially tangential to a respective point at which the each of the plurality of lighting devices contacts the inner surface of the housing; and wherein the light emitted by the light source of the each of the plurality of lighting devices passes through the substantially polygonal aperture in a generally orthogonal direction in relation to the orientation of the each of the plurality of lighting devices.

3. The luminaire according to claim **1** wherein the ferromagnetic material is positionable along at least the inner surface of the housing; and wherein a magnetic bond between the each magnetic attachment member and the housing is of sufficient force to carry the respective each of the plurality of lighting devices during normal operation.

4. The luminaire according to claim **1** wherein the heat sink comprises at least one thermally conductive material selected from the group consisting of thermoplastic, ceramic, porcelain, aluminum, and aluminum alloys.

5. The luminaire according to claim **4** wherein the housing comprises at least one thermally conductive material selected from the group consisting of thermoplastic, ceramic, porcelain, aluminum, and aluminum alloys; and

wherein a combined surface area of the respective heat sink of each of the plurality of lighting devices and of the housing is proportional to a thermal output of the plurality of lighting devices.

6. The luminaire according to claim 1 wherein the housing comprises a plurality of pads each molded into the inner surface and configured to receive a respective each of the plurality of lighting devices.

7. The luminaire according to claim 6 wherein the plurality of pads are disposed in a geometric pattern about the inner surface of the housing.

8. The iuminaire according to claim 6 further comprising one or more external power supply units carried by the housing adjacent the outer surface, wherein each of the one or more external power supply units is electrically connected to one or more of the plurality of pads; wherein each of the plurality of pads comprises a transmitter coil configured to transmit a DC voltage to a receiver coil on a respective each of the plurality of lighting devices through inductive coupling.

9. The luminaire according to claim 6 wherein each of the plurality of lighting devices further comprises an on-board power supply unit operatively coupled to the light source and coupled to the magnetic attachment member; wherein the on-board power supply unit comprises at least one of a converter and a regulator; wherein the converter is configured to convert an AC input voltage to a DC output voltage; wherein the regulator is configured to sustain a DC output voltage within a target DC bias range; wherein each of the plurality of pads comprises a transmitter coil configured to transmit an AC voltage to a receiver coil on a respective each of the plurality of lighting devices through inductive coupling.

10. The luminaire according to claim 6 wherein each of the plurality of pads comprises a plurality of electrical contacts.

11. The luminaire according to claim 10 further comprising one or more external power supply units carried by the housing adjacent the outer surface and each of the one or more external power supply units electrically connected to one or more of the plurality of pads; wherein each of the plurality of pads comprises an electrically conductive material and includes a positive contact and a negative contact configured to transmit a DC voltage to a respective each of the plurality of lighting devices through conductive coupling.

12. The luminaire according to claim 10 wherein each of the plurality of lighting devices further comprises an on-board power supply unit operatively coupled to the light source and coupled to the magnetic attachment member; wherein the on-board power supply unit comprises at least one of a converter and a regulator; wherein the converter is configured to convert an AC input voltage to a DC output voltage; wherein the regulator is configured to sustain a DC output voltage within a target DC bias range; wherein each of the plurality of pads comprises an electrically conductive material and includes a neutral contact and a live contact configured to transmit an AC voltage to a respective each of the plurality of lighting devices through conductive coupling.

13. The luminaire according to claim 1 further comprising a controller operably coupled to the plurality of lighting devices; wherein the controller is configured to selectively operate each light source of the plurality of lighting devices.

14. The luminaire according to claim 13 wherein each of the plurality of lighting devices further comprises a first light source operable to emit light within a first wavelength range corresponding to a first color, and a second light source operable to emit light within a second wavelength range corresponding to a second color.

15. The luminaire according to claim 13 further comprising a reflective primary optic disposed within the inner surface of the housing and positioned such that the light emitted by the light source of the each of the plurality of lighting devices is incident upon the reflective primary optic and is reflected by the reflective primary optic through the substantially polygonal aperture.

16. The luminaire according to claim 13 further comprising an occupancy sensor having a field of view;

wherein the controller is in communication with the occupancy sensor;

wherein the occupancy sensor is configured to determine whether an object is within the field of view of the occupancy sensor;

wherein the occupancy sensor is configured to transmit a positive indication when an object is determined to be within the field of view; and

wherein the controller is configured to operate the light source of each of the plurality of lighting devices to illuminate the field of view of the occupancy sensor upon receiving the positive indication.

17. The luminaire according to claim 14 further comprising a network interface configured to enable communication with a network;

wherein the controller is in communication with the network interface;

wherein the network interface is operable to receive communications across the network and provide an instruction to the controller; and

wherein the controller operates at least one light source of the plurality of lighting devices responsive to the instruction received from the network interface.

18. A lighting system comprising:

at least one network;

at least one luminaire comprising:

a generally concave elongate-shaped housing comprising a ferromagnetic material and having an outer surface and an inner surface opposite the outer surface, the inner surface defining an optical chamber and a substantially polygonal aperture,

a plurality of lighting devices each comprising a heat sink,

a light source in thermal communication with the heat sink, and

a magnetic attachment member,

wherein the heat sink and the light source are coupled to the magnetic attachment member;

at least one network interface configured to transmit and receive control instruction data through the at least one network; and

at least one controller operably coupled to a respective at least one of the lighting devices and configured to selectively operate at least one of the lighting devices responsive to the control instruction data received from the at least one network interface;

wherein the repsective magnetic attachment member of each of the plurality of lighting devices is magnetically mountable to the ferromagnetic material such that the plurality of lighting devices are positionable adjacent to and spaced apart about the inner surface of the housing, and such that light emitted by the respective light source of each of the plurality of lighting devices enters the optical chamber and passes through the substantially polygonal aperture.

19. The lighting system according to claim 18 wherein the at least one controller comprises a plurality of controllers; and wherein the at least one network further comprises a local network configured to enable data communication among more than one of the plurality of controllers.

20. The lighting system according to claim 18 wherein the at least one luminaire comprises a plurality of luminaires; and

wherein the at least one network further comprises a wide network configured to enable data communication among the at least one controller of more than one of the plurality of luminaires.

21. The lighting system according to claim **18** further comprising a sensor configured to determine whether an object is within a field of view of the sensor and to transmit as the control instruction data a positive indication when an object is determined to be within the field of view; and wherein the at least one controller is configured to selectively operate at least one of the plurality of lighting devices to illuminate the field of view responsive to the positive indication.

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